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Abstract

RADIOISOTOPE STUDIES OF ADAPTATION TO RESIDENCE AT HIGH ALTITUDES AND TO HEAT STRESS[1]

Dr. J. Metz and Prof. C. Wyndham
South African Institute for Medical Research and Applied Physiology Laboratory, Chamber of Mines, Johannesburg

Man's adaptation to environment may involve many physiologic processes, among the most important of which are changes in the body's fluid compartments. These changes in fluid compartments are often complex, and lend themselves particularly to study with radioisotopes. The present paper reports the results of such studies of adaptation to two aspects of environmental stress, viz. residence at high altitude, and physical labour under conditions of extreme heat.

While studies of blood volume, total body water and iron metabolism at altitudes above 16 000 ft in the Peruvian Andes have been reported, there is little published data on subjects resident at moderate altitudes at which large numbers of people reside. Studies have therefore been carried out on normal healthy male subjects resident at an altitude of approximately one mile (5 740 ft) above sea level and the results compared to those of subjects resident at sea level. Multiple tracer techniques have been used including measurement of red cell volume with ^{51}Cr, plasma volume with ^{131}I albumin, total body water with $^{3}H_2O$ and total exchangeable sodium with ^{22}Na. Complex changes associated with residence at the higher altitude have been found. The red cell volume is increased and the plasma volume decreased; in this way the total blood volume is not

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appreciably changed. The body venous haematocrit ratio is raised. The total body water is similar at altitude and at sea level, but the total exchangeable sodium tends to be lower at the high altitude, and the serum sodium concentration thus reduced.

Physical labour under conditions of heat is necessary in many industries, and study of man's adaptation to such conditions is of practical importance in the prevention of heat exhaustion and heat stroke. Studies have been carried out on normal volunteer subjects who performed physical labour in a heat chamber under conditions of extreme heat and humidity. Multiple radioisotope techniques were used to measure plasma volume, total body water and total exchangeable sodium. Studies included changes accompanying a single exposure to severe heat, as well as those following acclimatization to heat on successive exposures. While changes in plasma volume were not striking, marked changes in total body water and total exchangeable sodium were observed. Of particular interest was the comparatively long period required for re-establishment of equilibrium in the body's fluid compartments following exposure to extreme heat. It is hoped that the results of these studies will enable a rational approach to be made to the problem of acclimatization to work under conditions of extreme heat.